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APPLICATION NUMBER: *60/449,209*
FILING DATE: *February 21, 2003*
RELATED PCT APPLICATION NUMBER: *PCT/US04/04647*

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02-24-03 60/449209 Approved

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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

INVENTOR(S)

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☐ *Additional inventors are being named on the ____ separately numbered sheets attached hereto*

TITLE OF THE INVENTION (280 characters max)

Video Decoder Architecture Employing Loop Filter for HD Video Coding Efficiency Improvement

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

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ENCLOSED APPLICATION PARTS *(check all that apply)*

☒ Specification *Number of Pages*	1	☐ CD(s), Number	
☒ Drawing(s) *Number of Sheets*	1	☐ Other (specify)	
☐ Application Data Sheet. See 37 CFR 1.76			

METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT *(check one)*

		FILING FEE AMOUNT ($)
☐ A check or money order is enclosed to cover the filing fees		
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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

☒ No.

☐ Yes, the name of the U.S. Government agency and the Government contract number are: _____

Respectfully submitted,

SIGNATURE

Date 02/21/03

REGISTRATION NO. *(if appropriate)* 25,124

Docket Number: 17366-0550

TYPED or PRINTED NAME **Joseph W. Price**

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USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

This collection of information is required by 37 CFR 1.51. The information is used by the public to file (and by the PTO to process) a provisional application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 8 hours to complete, including gathering, preparing, and submitting the complete provisional application to the PTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, Washington, D.C. 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Box Provisional Application, Assistant Commissioner for Patents, Washington, D.C.

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CERTIFICATE OF MAILING BY "EXPRESS MAIL" (37 CFR 1.10) Applicant(s): **Jiuhuai Lu, Yoshiichiro Kashiwagi, Masayuki Kozuka**	Docket No. **17366.0550**

Serial No.	Filing Date	Examiner	Group Art Unit
TBA	**Herewith**	**TBA**	**TBA**

Invention: **Video Decoder Architecture Employing Loop Filter for HD Video Coding Efficiency Improvement**

I hereby certify that this **Provisional Patent Application**
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Video Decoder Architecture Employing Loop Filter for HD Video Coding Efficiency Improvement

February 18, 2003

Jiuhuai Lu, Yoshiichro Kashiwagi

Summary of the Innovation

This disclosure provides a description of new concept in high definition video decoder that improves video coding efficiency in MPEG-4 AVC and other coding schemes, especially for high definition visual content. In recent effort to improve video picture decoding quality, video post filters and loop filter have been adopted to mitigate compression artifacts and reduce propagation of compression errors from motion compensation. Although these techniques are successful, they all suffer from the same problem of reducing texture details.

HD videos originated from films and high resolution professional video cameras have been able to capture great amount of texture details. However, increase in spatial resolution of pictures is not coupled with increase in temporal resolutions. As a result, redundancy reduction attempted by motion compensation does not perform as effective as in pictures of lower resolutions because irregular local motion. The less degree of texture correlation between reference and motion compensated pictures reduces coding efficiency. This innovation provides a solution to this problem without significant change of architecture. The solution is concerning the use of loop filter to create relative smooth pictures for motion references, and therefore to minimize the energy of uncorrelated textures. This method is most effective for high quality coding of high resolution video and motion pictures.

The existing loop filter schemes, such as the deblocking filters provided in MPEG-4 compression AVC/H.264 standard have been used for reducing artifacts and error propagation. This new role of loop filters creates smooth version of pictures only for reference to be used for motion compensation. For that purpose, we introduce an architectural modification which enables a loop filter with a new function that offers coding efficiency improvement in addition to compression artifact reduction and error propagation.

Example: MPEG-4 AVC

In the current specification of the MPEG-4 AVC decoder architecture, the loop filter is depicted in a block diagram in Figure 1. The output of the loop filter goes to the display device as well as the frame memory to be used for references.

To allow it to function as a reference picture smoother only separating from the decoded video to be displayed, the loop filter is re-position as illustrated in Figure 2. When the decoder is signaled to use the loop filter only as a reference picture smoothing filter, the filter only applies to pictures that need to be stored for reference. In that case, the filtered version of decoded pictures is not output to display devices. The signal is essentially a flag sent by the encoder and carried by the video bitstream. In this specific case, a flag "deblocking_filter_for_motion_pred" is added into the bitstream syntax and can be assigned by the encoded. More specifically, it shall be placed in the data structure, Picture Parameter Set (pic_parameter_set_rbsp), in the MPEG-4 AVC bitstream.

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Depending on video content and coding bit-rate, the encoder can flag a decoder to use the loop filter only for motion reference purpose. Encoder can use it in the following conditions but not limited to:

1. large amount of texture with irregular motion details
2. large amount of film grains
3. medial to high bit rate
4. no blocking artifact

Conclusions

This disclosure defines switchable loop filter position which can be controlled by encoder to signal to decoder whether the loop filter shall be used as post processing and deblocking filter or as a reference picture processing filter for improving motion compensation efficiency.

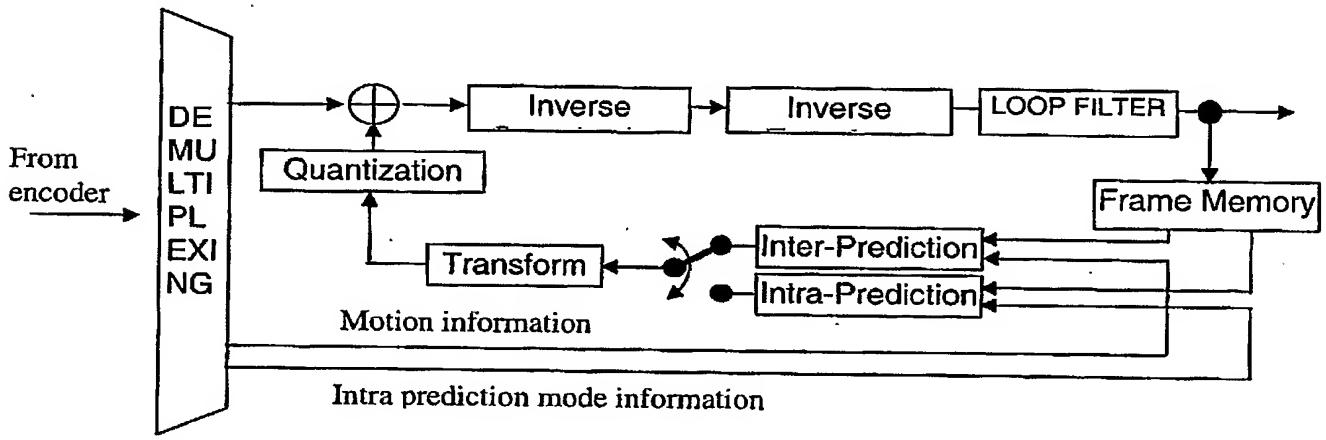

Figure 1. Current architecture a MPEG-4 AVC decoder.

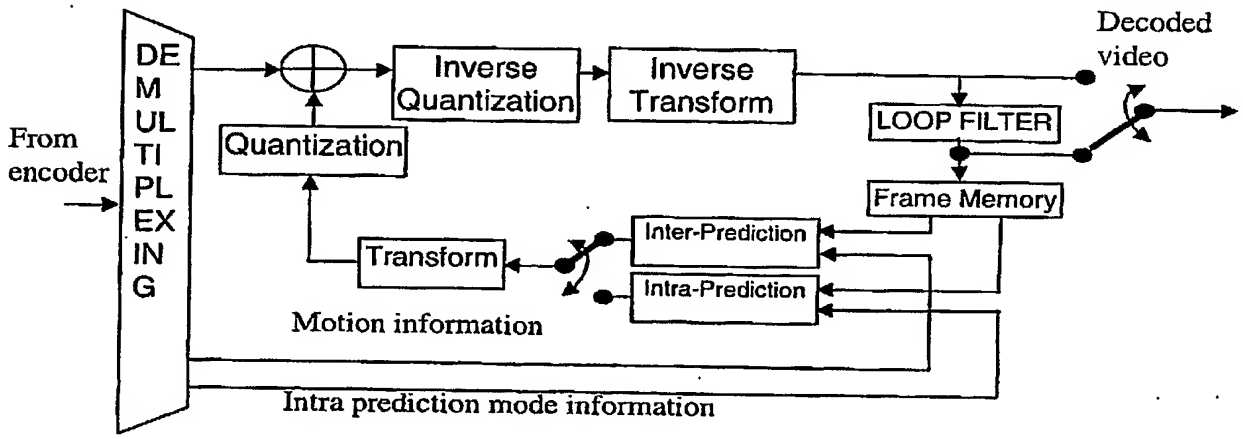

Figure 2. New architecture of a MPEG-4 AVC decoder for high resolution and high quality visual content.

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